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THE

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THE PROBOSCIDIA.

BY E. D. COPE.

THE Proboscidia are Ungulata in which the second row of carpal bones has not moved inwards so as to alternate with the first, and in which the second row of tarsal bones alternates with the first by the navicular extending over part of the proximal face of the cuboid. The teeth are modifications of the quadritubercular type, and canines are absent.

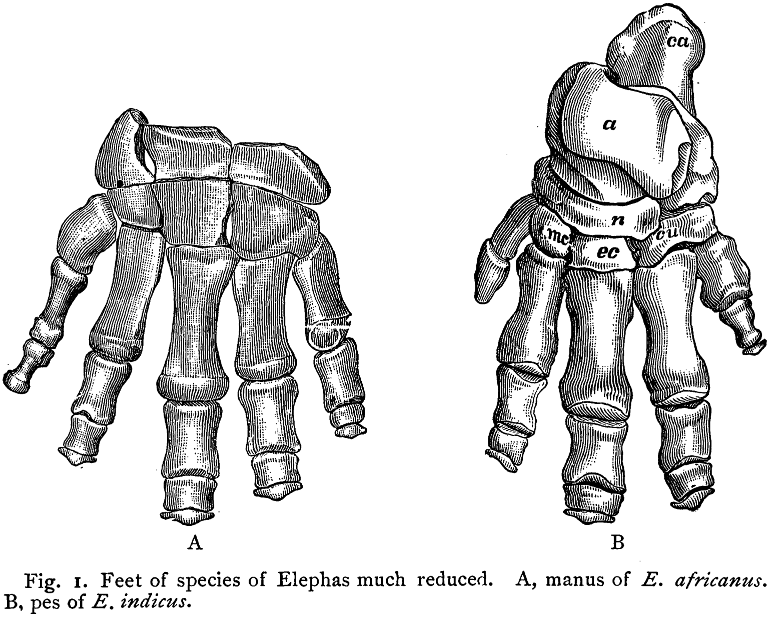


Fig. 1. Feet of species of Elephas much reduced. A, manus of *E. africanus*. B, pes of *E. indicus*.

To these general characters are added numerous subordinate peculiarities in the known genera and species, which make them among the most remarkable of living beings. These peculiarities are the result of a long period of development. It is one of the most curious facts of paleontology that the order does not make its appearance until the middle of the Miocene system, and the greater number of forms do not appear until the upper Miocene. That it existed earlier cannot be doubted, and that it originated from some Eocene condylarthran is evident; but the intermediate forms are entirely lost to us as yet, and the phylogeny of the order is absolutely unknown. This is the more extraordinary since the earliest known genus (Dinotherium) embraces only species of colossal size, and its immediate ancestors could not have been insignificant. We may regard Phenacodus as the first form we know of earlier than Dinotherium, but what a hiatus is expressed in this statement! It is to be anticipated that the gap will be filled by discoveries in Asia, or the Southern Hemisphere. South America may be probably excluded from this prospect, since the extensive researches made there by Burmeister, Ameghino, and Moreno, have not resulted in the discovery of any Proboscidia earlier than the Pliocene. Asiatic investigations have revealed nothing, as the proper formations have not been found, and the same is true of Africa. So we shall have to wait until the paleontology of the present home of the order is exposed to view, before we shall know of the steps which lead from Phenacodus to these mighty monarchs of the animal kingdom. The absence of primitive Proboscidia from North and South America and Europe, impels us to believe that the representatives of the order known to us from those regions, are the descendants of immigrants from Asia and Africa.

But two families of Proboscidia are known. They are defined as follows:

Adult dentition embracing premolars and molars; no superior incisors.................................*Dinotheriidæ.*

Adult dentition embracing one or two true molars only; superior incisors.................................*Elephantidæ.*

The family of the Dinotheriidæ embraces one genus and four species, though a fifth species, *D. sindiense* Lyd., from India, may belong, according to Lydekker, to another genus. The *Dinotherium indicum* Falc. is known from a few teeth, which exceed in size those of the other species. The *D. giganteum* Kaup is found in several Miocene deposits of Europe. It was one of the largest of Mammalia, its femur exceeding in dimensions that of any other land mammal. The inferior incisors were robust and cylindric in form. With the symphysis of the lower jaw they are decurved so as to form a most effective instrument for the tearing up of trees by the roots, or the pulling down of their branches The temporal fossa is lateral, and the top of the head flat. The premaxillary region though toothless, is prominent, and the nasal bones do not project. There is supposed to have been a short trunk. The skull measures three feet eight inches in length. (Plate XV.)

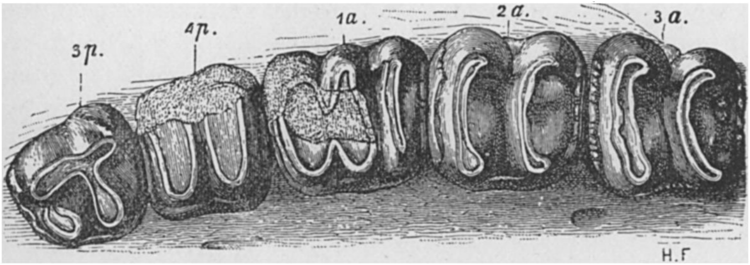


Fig. 2. *Dinotherium giganteum* Cuv. left superior molars, one fourth nat. size. From the Miocene of France. From Gaudry.

Two smaller species are known, the *D. bavaricum* from European, and *D. pentapotamiæ* from Indian Miocene beds.

In Dinotherium all the molars and premolars have two transverse crests excepting the first (posterior) premolar, and its deciduous predecessor, which have three cross-crests.

The genera of the Elephantidæ are the following :

I. Inferior incisors and premolars present.
Superior incisors with enamel-band........................ *Tetrabelodon* Cope.
II. Premolars, but normally no inferior incisors ;
Intermediate molars isomerous ; superior incisors with enamel-band.
Dibelodon Cope.
Intermediate molars isomerous superior incisors without enamel-band.
Mastodon Cuv.

Intermediate molars heteromerous; superior incisors without enamel-band.
Emmenodon Cope.[1]

III. No premolars, nor inferior incisors;
Intermediate molars heteromerous. Superior incisors without enamel-band.
Elephas Linn.

The characters assigned to the above genera are sufficient to separate them, but they have not come into general use for two reasons. One is the difficulty of verifying some of them, especially the presence of premolars, owing to the difficulty of obtaining specimens of young individuals. The other is the indisposition of naturalists to abandon the system of Falconer. As is well-known, this able paleontologist distinguished the genera by the number and depth of the transverse crests of the molar teeth, and the extent to which their interspaces are filled with cementum. This arrangement is insufficient, since it neglects the equally important characters above

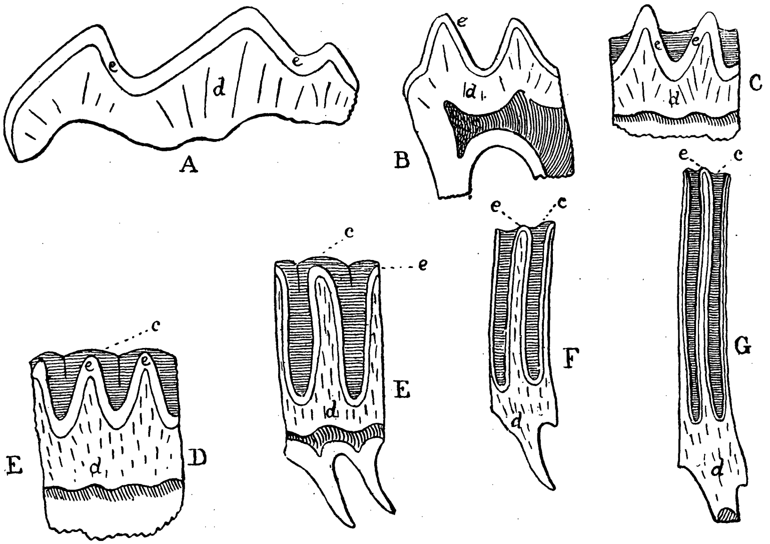
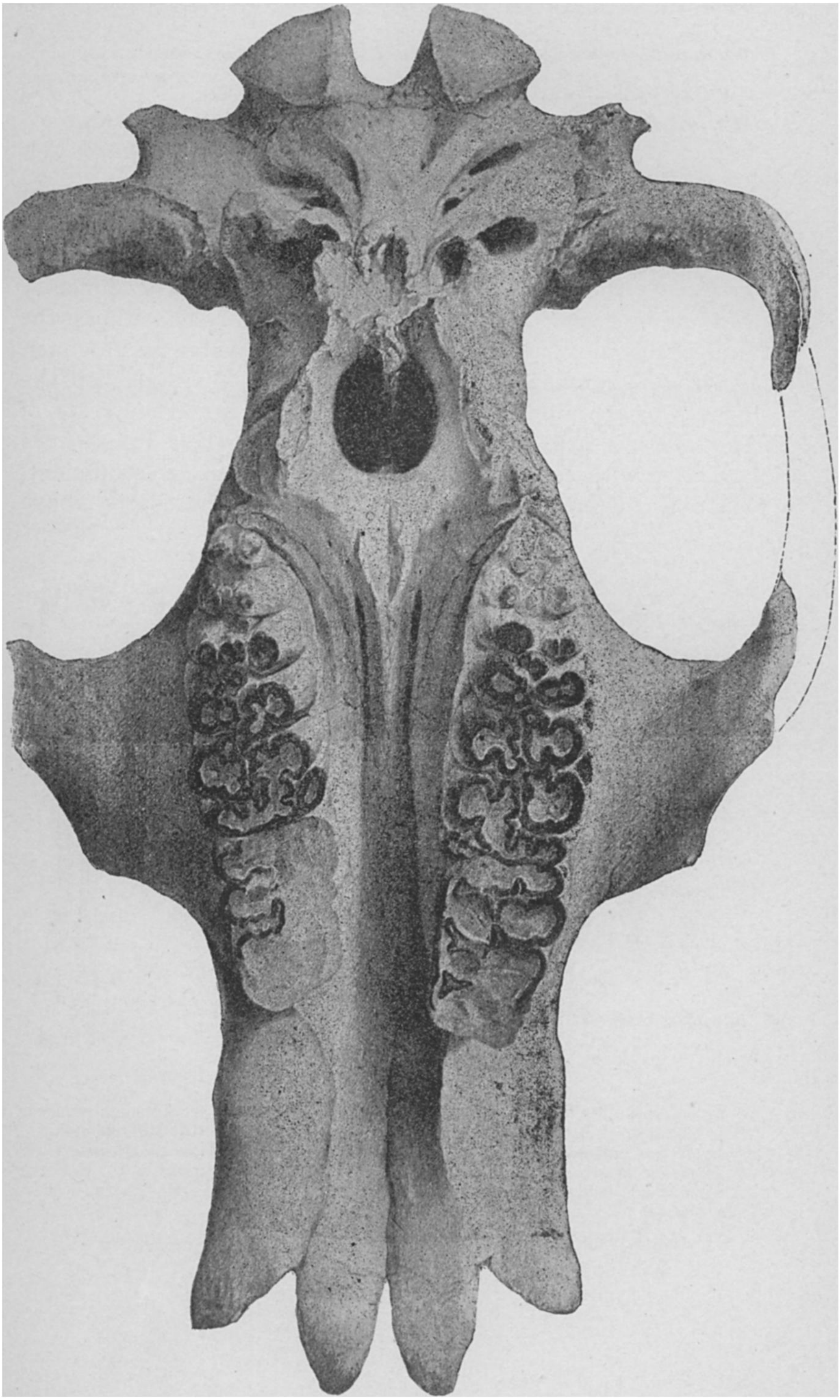


FIG. 3. Longitudinal sections of the molar teeth of Proboscidia, much reduced, from Gaudry. Letters; *c* cementum; *d* dentine; *e* enamel. A, Inferior molar of *Dinotherium giganteum* Cuv. B, superior molar of *Mastodon americanus* Cuv. C, lower molar of *Elephas ganesa* C. F. D, do. of *Elephas insignis* C. F. E, do. of *Emmenodon planifrons* C. F. F, do. of *Elephas hysudricus* C. F. G, do. of *Elephas indicus* L.

[1] Gen. nov. Type *Elephas cliftii* Falc. Cautl., *Mastodon elephantoides* Clift.

PLATE IX.



Tetrabelodon campester Cope.

mentioned ; and as observed by Lydekker[1] it fails to furnish clear definitions. He remarks, under the head of the genus Elephas, " There is no character by which the present genus can be distinguished from Mastodon ; and the division can be therefore only regarded as a matter of convenience." The characters presented in the above table are on the other hand very distinctive, and can be applied in all cases where we have the necessary information. This has not yet been obtained as regards all the species, and I have placed some of them in their respective genera provisionally. Such species are marked with an *i* when the condition of the incisors is unknown, and with a *p* when the same is true of the premolars. The species of the family described thus far, are as follows :

Tetrabelodon	*brevidens*[3]	Cope sp. nov. N. America *i. p.*
"	*turicensis*	Schinz. Europe.
"	*angustidens*	Cuv. Europe.
"	" *palæindicus*	Lyd. India.
"	" *proavus*	Cope. N. America.
"	*productus*	Cope. N. America, ? Mexico.
"	*euhypodon*	Cope. N. America *p.*
"	*pandionis*	Falc. Cautl. India.
"	*pentelici*	Gaudry.[4] Europe *p.*
"	*campester*	Cope. N. America. *p.*
"	*longirostris*	Kaup. Europe.
"	*? serridens*	Cope. Texas ?Mexico ?Florida.[5] *i. p.*
Dibelodon	*shepardi*	Leidy. California, Mexico. *p.*
"	*cordillerarum*[6]	Desm. South America.
"	*tropicus*	Cope. South America and Mexico. *p.*
"	*humboldtii*	Cuv. S. America.
Mastodon	*americanus*	Cuv.[7] N. America.
"	*borsoni*	Hays. *p.* Europe.
"	*falconeri*	Lydd. India. *p.*

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[1] Catalogue of fossil Mammalia in the British Museum Pt. IV. p. 79.

[2] In compiling this list I have been greatly aided by the Memoirs of Lydekker in the Palæontologia Indica; and in the Catalogue of the British Museum.

[3] *M. proavus* Cope 1884 not 1873.

[4] According to Lydekker no premolars have been seen in this species.

[5] *M. ?floridanus* Leidy.

[6] *M. andium* Cuv. According to the recent researches of Burmeister, this species does not possess mandibular tusks. (Sitzungsb. Kön. Preuss. Akad. Wiss. Berlin 1888 p. 717.) Hence the specimens from Mexico with such tusks reported by Falconer, must be assigned elsewhere.

[7] This species is said by Lydekker not to possess premolars. Leidy Report U. S. Geol. Surv. Terrs. Pl., figures a tooth as a premolar, and similar specimens are not uncommon.

Mastodon *mirificus* Leidy. N. America. *i. p.*
" *sivalensis*[1] Cautley. India. *p.*
" *arvernensis* C. & J. Europe.
" *?punjabiensis* Lydd. India. *p.*
" *latidens* Clift. India.
Emmenodon elephantoides[2] Clift. India to Japan.
" *planifrons* Falc. Cautl. India.
Elephas bombifrons Falc. Cautl. India, ? China.
" *ganesa* Falc. Cautl. India.
" *insignis* Falc. Cautl. India to Japan.
" *meridionalis* Nesti. Middle and S. Europe, and N. Africa.
" *hysudricus* Falc. Cautl. India.
" *antiquus* Falc. Europe ? W. Africa.
" *mnaidriensis* Leith-Adams. Malta.
" *melitensis* Falc. Malta.
" *namadicus* Falc. Cautl. India to Japan.
" *primigenius columbi* Falc. W. N. America, Mexico.
" " *primigenius* Blum. N. Hemisphere.
" " *americanus* DeKay. E. N. America.

To these we must add the two existing species, *Elephas africanus* and *E. indicus*. Several species are not sufficiently known for reference to their proper genus. Such are *Mastodon perimensis* Falc.Cautl. India ; *M. atticus* Wagn. S. Europe ; *M. serridens* Cope, Texas ; *M. cautleyi*, Lydd. India, and *M. obscurus* Leidy, N. America. In these the characters of both the incisor and premolar teeth are unknown. In some

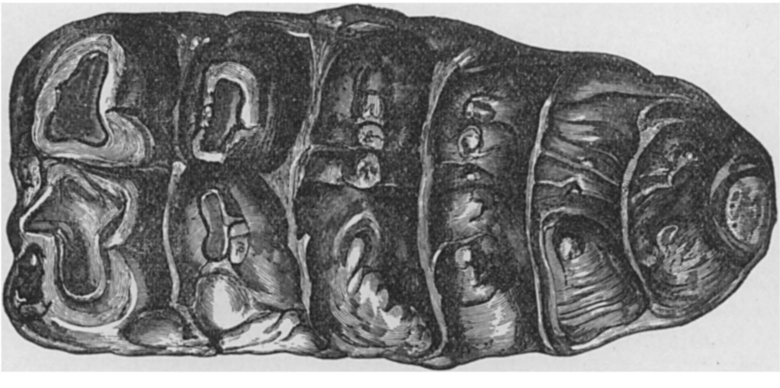

Fig. 4. *Mastodon latidens* Clift left sup. molar 3 from ? Pliocene of Borneo: two-thirds natural size. From Lydekker.

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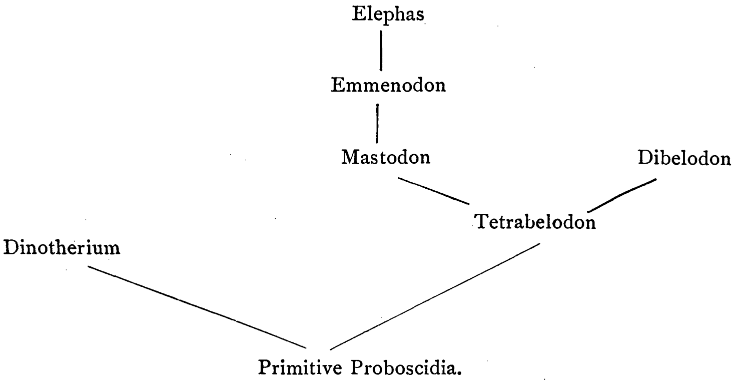
[1] According to Lydekker, premolars have not been observed.
[2] *Mastodon* Clift; *Stegodon* Falconer; *Elephas* Lydekker.

of the species referred above to Mastodon, mandibular tusks are present in the young, and occasionally one is retained to maturity, as sometimes seen in *M. americanus*. But such individuals are exceptional among their species. In some other species while the males possess them, they are wanting to the females. The specific character is in this case derived from the male.

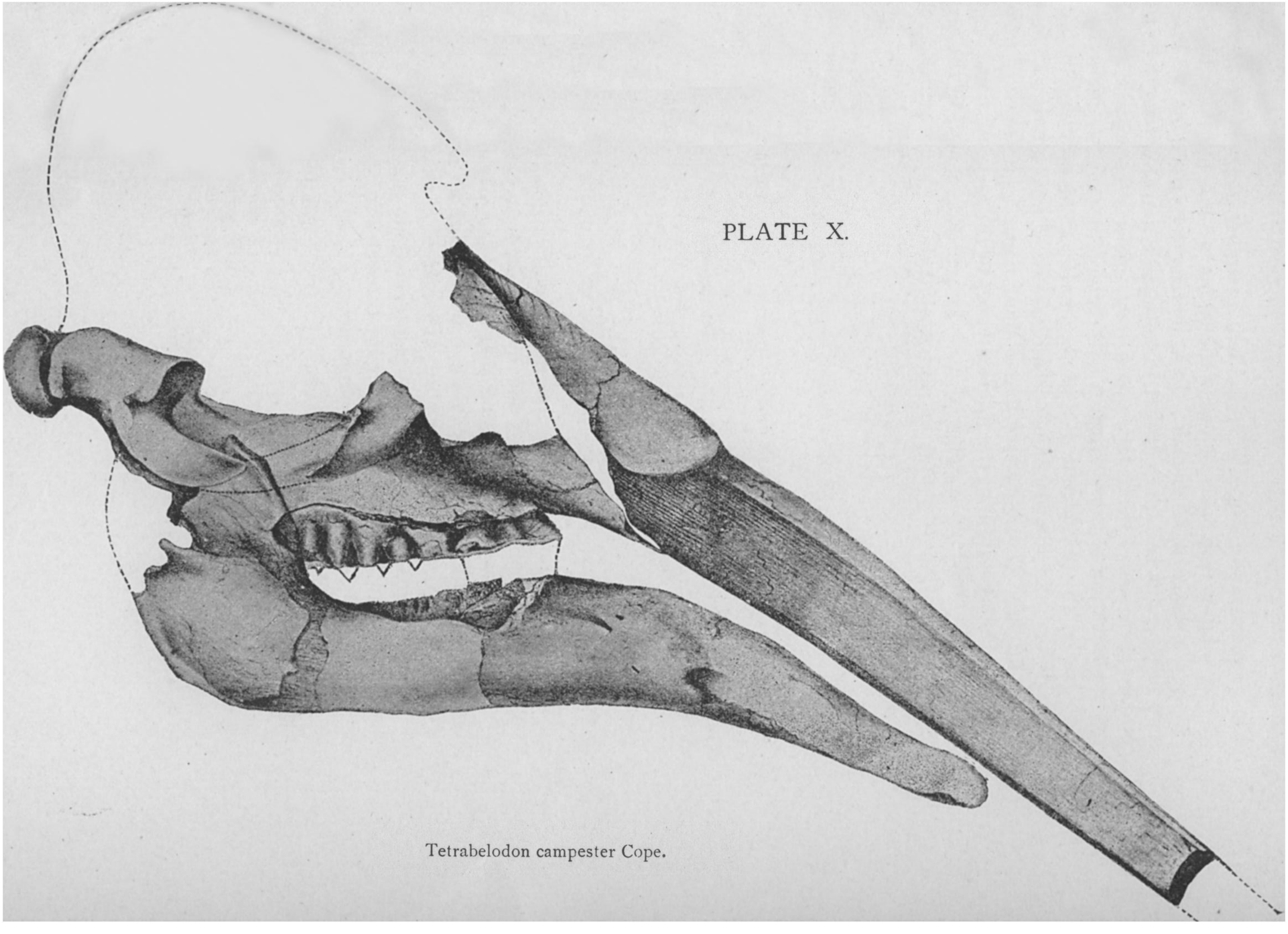
The molar dentition in this family possesses a number of peculiarities which have been worked out mainly by Falconer, Owen, and Lydekker. There are probably deciduous molars in all the species, and they are generally three in number. The posterior of these has the same number of cross-crests as the posterior premolar, which immediately succeeds it. The number of crests diminishes to the first of the series. There are two or three premolars in most forms of the family, but in the genus Elephas they have disappeared. In all the species they are shed early in life in order to make way for the true molars. As the latter teeth are very large, and the fore and aft extent of the jaws is small, there is only space for one or two of them at a time. In most of the species the last molar so much exceeds the others in size, that it occupies the entire jaw, and the other molars are shed in order to accommodate it. In the genera Tetrabelodon, Dibelodon, and Mastodon, the last premolar, and the first and second true molars are isomerous, *i. e.* have the same number of cross-crests. In Emmenodon and Elephas they are heteromerous ; that is, the number of cross-crests successively increases from front to rear. Thus in the three genera named the ridge formula is ; P. M. 2—2—3 ; M. 3—3—4, and P. M. ?—? 4 ; M. 4—4—5 or 4—5—6. In Emmenodon the ridge formula is, P. M. ?—?—?—5 ; M. 6-7—6—7-8 ; and P. M. ?—6-7 ; M. 7—8-9—10-12. In Elephas the formula extends from M . 6—6-7—8-9, to M. 9-15—14-16—18-27. Each genus then has a certain range of variation in the number of molar crests, extending from a smaller to a larger number. This successive increase in complexity has been regarded by Falconer as the index to the successive evolution of the species, and rightly so. As already remarked, however, other measures of the same succession cannot be overlooked, especially as the ridge formula changes in so gradual a manner as to render it unavailable as a basis of exact divisions, as has been remarked already by Lydekker. It is evident that the primitive Proboscidia had incisor teeth in both jaws, and that these had more or less of the usual enamel investment. The gradual modification of these features is therefore another indication of the line of descent of these animals. The primitive Proboscidia had likewise four premolars, as is now seen in Dinotherium. The successive loss of these teeth is no less an index of the evolution of the modern types of the order, than the other modifications referred to. In general, then, the phylogeny of the order may be represented thus:



Within each genus certain parallel modifications of the composition of the crowns of the molar teeth may be observed. The cross-crests may be single, or they may be divided up into tubercles. The valleys between them may be open (1) or they may be blocked by (2) a system of single intermediate tubercles; (3) by numerous intermediate tubercles; or (4) by the thickening of the primary tubercles. I arrange the species according to these characters.

	Tetrabelodon.	Dibelodon.	Mastodon.
1	*T. ? brevidens.*		*M. americanus.*
	T. turicensis.		*M. borsoni.*
			M. latidens.
2	*T. angustidens.*	*D. shepardi.*	*M. ? cautleyi.*
	T. productus.	*D. cordillerarum.*	*M. falconeri.*
	T. serridens.	*D. tropicus.*	

PLATE X.



Tetrabelodon campester Cope.

	T. euhypodon.		*M. arvernensis.*
	T. longirostris.		
3	*T. campester.*	*D. humboldtii.*	?*M. sivalensis.*
	T. pandionis.		*M. punjabiensis.*
4			*M. mirificus.*
			?*M. atticus.*

Parallels between the species of Emmenodon and Elephas also exist. As but two species of the former genus are known, we must look for future discoveries to increase the number of correspondences. The species of both genera which approach nearest to Mastodon have a smaller number of cross-crests, which are of lesser elevation, and whose intervening valleys are occupied by but a shallow deposit of cementum (fig. 3, C. D.) These are the Stegodons of Falconer; (1). In the other group, (2) the crests are numerous and elevated, and their interspaces are filled with cementum. (Fig. 3, E. F.)

	Emmenodon.	Elephas.
1	*E. elephantoides.*	*E. bombifrons.*
		E. ganesa.
		E. insignis.
2	*E. planifrons.*	*E. meridionalis.*
		E. hysudricus.
		E. antiquus. etc.

It is observable that each type of molar teeth of the three genera first compared, has representatives in the regions where their species occur ; North America, Europe and India.

The North American species of this family are distinguished by the following characters of the molar teeth.[1]

I. Intermediate molars with not more than three crests ; (trilophodont).

a. Crests acute, transverse.

β. Valleys uninterrupted.

Last superior molar with three crests and a heel; crests low, not serrate. *T. brevidens.*

Last superior molar with four crests and a heel; crests elevated, not serrate. *M. americanus.*

ββ. Valleys interrupted.

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[1] From the AMERICAN NATURALIST. 1884. p. 524.

Edge of crest tuberculate.. *T. serridens.*

aa. Crests transverse, composed of conic lobes.

β. Valleys little uninterrupted.

Last inferior molar narrow, with four crests ; an accessory tubercle in each valley; *D. shepardi.*

β. Valleys interrupted.

Last inferior molar with four crests and a heel ; symphysis short, M. 150; smaller size.. *T. euhypodon.*

Last inferior molar with four crests and a cingulum ; symphysis longer, M. .280 ; size medium.. *T. productus.*

Last inferior molar with five crests and a heel; symphysis very long, M. .450 ; size largest.. *T. angustidens.*

"*aaa.* Crests broken into conic lobes ; those of opposite sides alternating.

Last inferior molar narrow, supporting four crests and a heel....... *T. obscurus.*"

II. Intermediate molars with four transverse crests ; (tetralophodont).

A long symphysis; crests well separated, tubercular, with accessory lobes interrupting valleys.. *T. campester.*

Symphysis very short; crests thick, closing valleys by contact; no accessory cusps; (Leidy).. *M. mirificus.*

III. Intermediate molars with 9–16 crests.

β. Valleys filled with cementum.

Last molar with 18–27 cross-crests ; .... *Elephas primigenius.*

The stratigraphic position of these species is as follows :

Pleistocene.
  Mastodon americanus.
  Elephas primigenius (less abundant).
Pliocene.
  Elephas primigenius (more abundant).
  Tetrabelodon serridens (horizon probable).
  Dibelodon shepardi.
Upper Miocene (Loup Fork).
  Tetrabelodon euhypodon.
    " *productus.*
    " *angustidens.*
    " *campester.*
  Mastodon mirificus.
Ticholeptus bed.
  Tetrabelodon brevidens.

The horizons from which were obtained the *Tetrabelodon obscurus* Leidy and the *Dibelodon shepardi* Leidy, are not sufficiently well-known. In the valley of Mexico, the *D. shepardi* is from the Pliocene. No species of the order has been found below the Ticholeptus beds ; a horizon about parallel with that in which the order first appears in Europe. The statement of Marsh that the genus has been obtained in the lower White River beds is an error. (King, Survey 40th parallel, I p. 412.)

The *Tetrabelodon brevidens* Cope is the oldest North American species, and presents a very simple type of molar. The last superior has but three cross-crests and a heel, a smaller number than exists in any other species of the genus. The tooth is wide, and the crests are low. They are well divided in the middle by a fissure. Their edges are entire, but obtuse, and the first and second internal have a thickening at the base next the median fissure, which wears into a trefoil. These thickenings close the valleys at their base, but soon spread apart. They are absent from the third crest. The valleys are bounded on the inner side by a well defined ledge, which is represented by a rudiment on the external side. Enamel thick and smooth. Length of molar, 157 mm.; width at second crest, 98 mm.; elevation of second crest, 54 mm. This tooth resembles that of the *Mastodon americanus* more nearly than that of any other North American species, and is still more like that of the *M. borsoni* of Europe. The reduced number of its crests indicates it as the most primitive

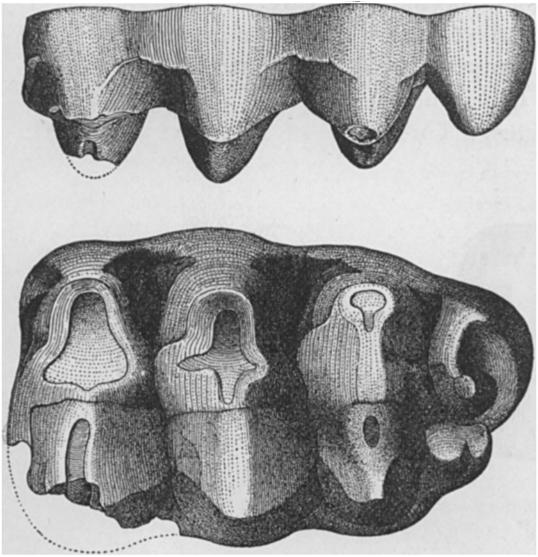


FIG. 5. *Tetrabelodon brevidens* Cope; last superior molar; from Ticholeptus bed of Montana. Four-ninths natural size. Original.

of the elephants, and as its horizon is the oldest, I have suspected that it had well developed incisor teeth in the lower jaw, and have, therefore, placed it provisionally in the genus Tetrabelodon. It is probably ancestral to the *M. americanus*, but, perhaps, not through American forms, since none with the same type of molar have been yet found in the formations which intervene between those in which the two species occur. Such forms occur in Europe, as the *Tetrabelodon turicensis* and the *Mastodon borsoni*. Unless some species of synchronous age with these is found in North America, we may suppose that the *Mastodon americanus* derived its immediate descent from Asiatic and European forms.

With the *Tetrabelodon angustidens* Cuv. we commence the series in which the transverse crests of the molars have the appearance of being composed of distinct but appressed conic tubercles. In most of them, the valleys are more or less interrupted by tubercles. This is one of the most abundant, as well as the most widely distributed species of the family, extending its range from India to Central North America, through Europe. I have seen specimens from the Loup Fork beds of Kansas, Nebraska, and Dakota. Their size exceeds those of the typical European form, and the second (and probably third) true molars have a narrow fourth cross-crest. It is possible that it may become necessary, with more complete information, to distinguish this form as a species

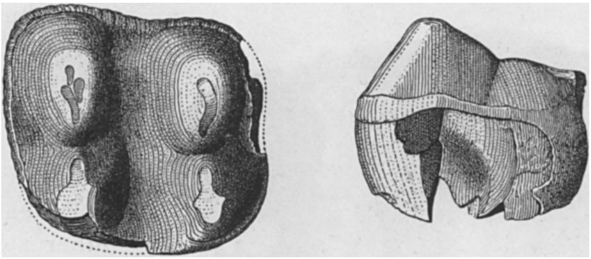
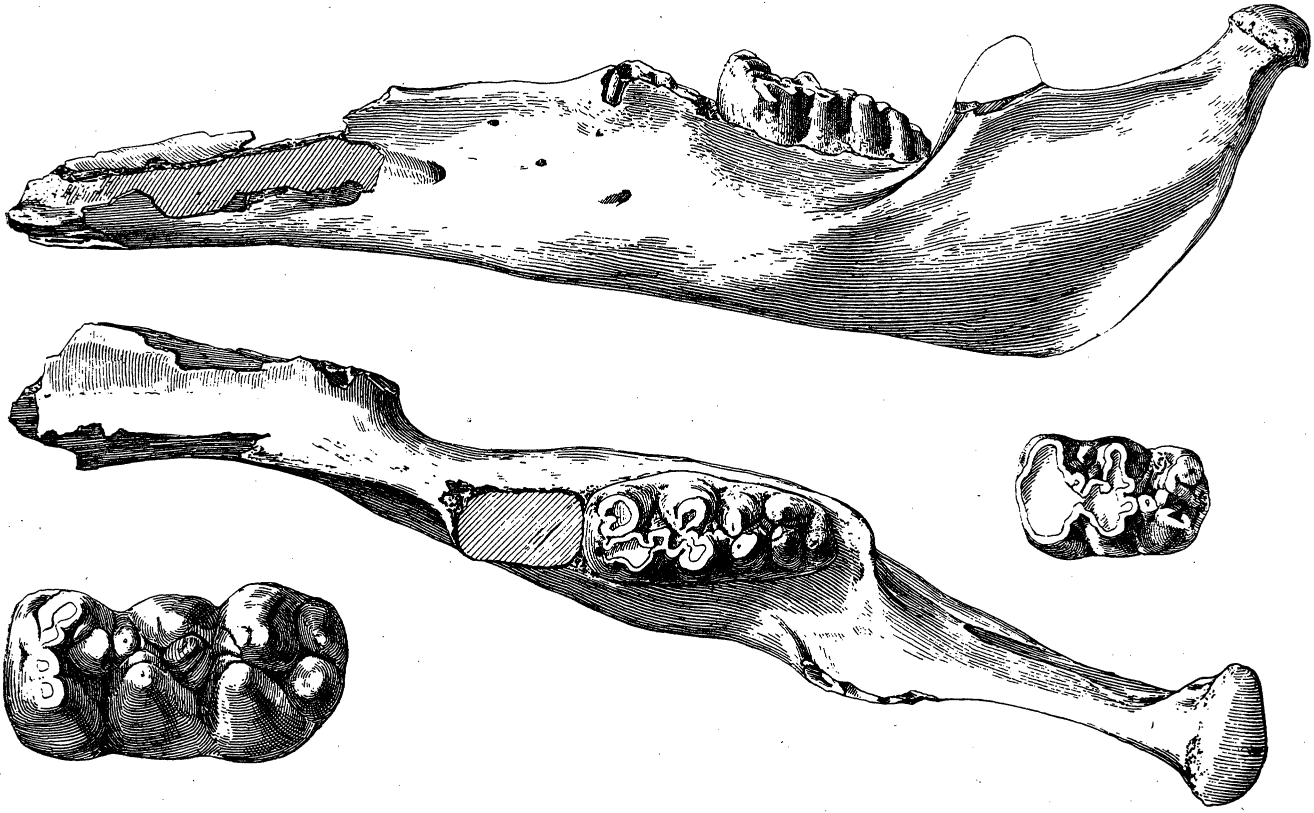


FIG. 6. *Tetrabelodon angustidens proavus* Cope; typical specimen from the Loup Fork bed of Colorado, two-thirds natural size. Original.

PLATE XI.



Tetrabelodon proavus Cope.

under the name of *Tetrabelodon proavus*.[1] Probably, the same species has been recorded by Whitfield, from the phosphate beds of South Carolina, and compared with *M. obscurus*. The skeleton of the European form is represented in Plate XII. In a lower jaw in my possession, the left ramus measures m. 1.080 in length, of which .420 is symphysis.

The *Tetrabelodon euhypodon* Cope was founded on a nearly perfect left mandibular ramus with last molar tooth and tusk,

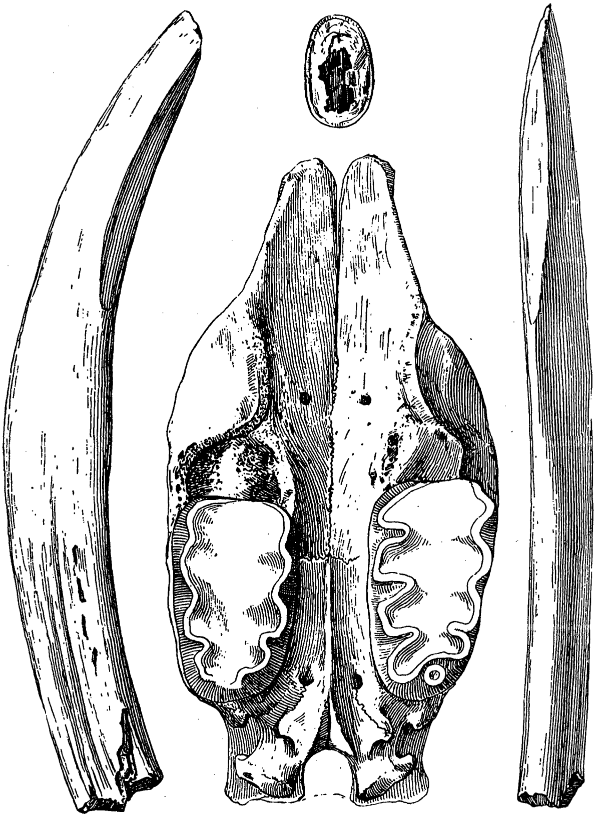


FIG. 7. *Tetrabelodon euhypodon* Cope; Loup Fork bed of Kansas. Palate with superior molars and superior incisors, of individual represented in Plate XIII; one-seventh natural size. Original.

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[1] This species was originally represented by a penultimate milk molar, with two cross-crests, and the fragments of a probable last premolar. The former is about the size of that of the *M. angustidens*, but is more regularly quadrangular, and is composed of but four tubercles, united in pairs. (Fig. 6.)

with entire palate with both last molar teeth and tusks. The superior tusks are compressed distally, and the inferior tusks are large and have an enamel band ; they are cylindric. The jaws indicate a smaller species, but the molar teeth are as large as those of the larger American form of *M. angustidens*, and as long as that of *M. americanus*, but narrower. Its symphysis is not prolonged, and the ramus is low and not compressed. Length of ramus posterior to symphysis, M. .500 ; of last lower molar, .182 ; width of do., 75. The mental tusk is much larger than that of *M. productus* or *M. angustidens*. Diameter of its alveolus, .068. There are several marked peculiarities in this species. The symphysis is remarkably short, when we consider the large size of the inferior tusks. The superior tusks are remarkably compressed for a considerable part of their length distally, having a vertically oval section. From the Loup Fork bed of Kansas.

Tetrabelodon productus Cope is abundant in the Loup Fork beds of New Mexico. It is a species of about the dimensions of the *T. angustidens* Cuv., but the symphysis is not so produced, and the ramus of the lower jaw is not compressed and elevated. It is the only species in which three superior premolars have been demonstrated; other species having generally two. The second and third true molars are in use at one time.

Tetrabelodon campester Cope is a rather large species, with a very long symphysis of the lower jaw, and a low ramus. The teeth are tetralophodont, and the sixth molar has six cross rows of tubercles and a heel. It is in some measure allied to the *T. longirostris* of Europe, but the symphysis is longer, and the teeth are more complex. The tusks are cylindric and nearly straight, and have a wide band of enamel. The known specimens are from the Loup Fork beds of Kansas and Nebraska. (Plates IX, X.)

The *Dibelodon shepardi* Leidy was founded on an inferior sixth molar tooth from California. I subsequently[1] described specimens of the same from the Pliocene bed of the valley of Mexico, where it was abundant. The molar teeth are rather simple in construction, and resemble those of the *D. cordillerarum* Desm., but the species has a short, elephant-like symphysis.

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[1] "Proceed. Amer. Philosoph. Society," 1884, p. 5.

The *Tetrabelodon serridens* Cope was founded on a first or second true molar from Texas. It is peculiar among American species in its acute elevated, entire crests, with tuberculo-serrate edges. It thus resembles the *M. turicensis*, but differs in well-developed longitudinal crests at the inner end of the external half of the crests, which consist of two tubercles on the posterior side of a crest, and one on the anterior side of the next succeeding crest. Strong anterior and posterior cingula ; edge of each cross-crest with six or seven tubercles. Length of crown, M. .130 ; width, .080 ; elevation, .061 Length of *M. americanus*, but narrower. Remains of a large Tetrabelodon from Florida have been described by Leidy under the name of *T. floridanus*. Its molars present

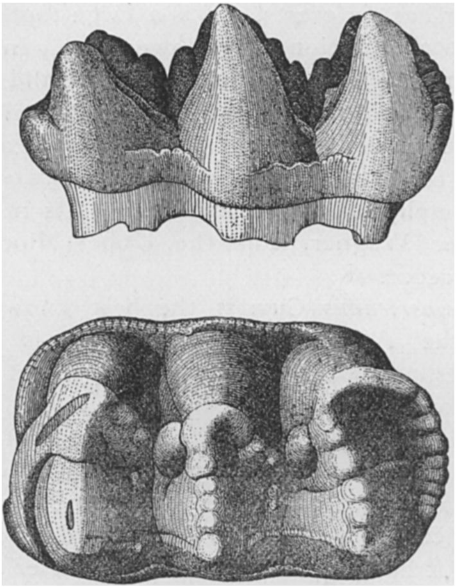


FIG. 8. *Tetrabelodon serridens* Cope; ?first molar. Typical specimen from ?Pliocene of Texas. Four-ninths natural size. Original.

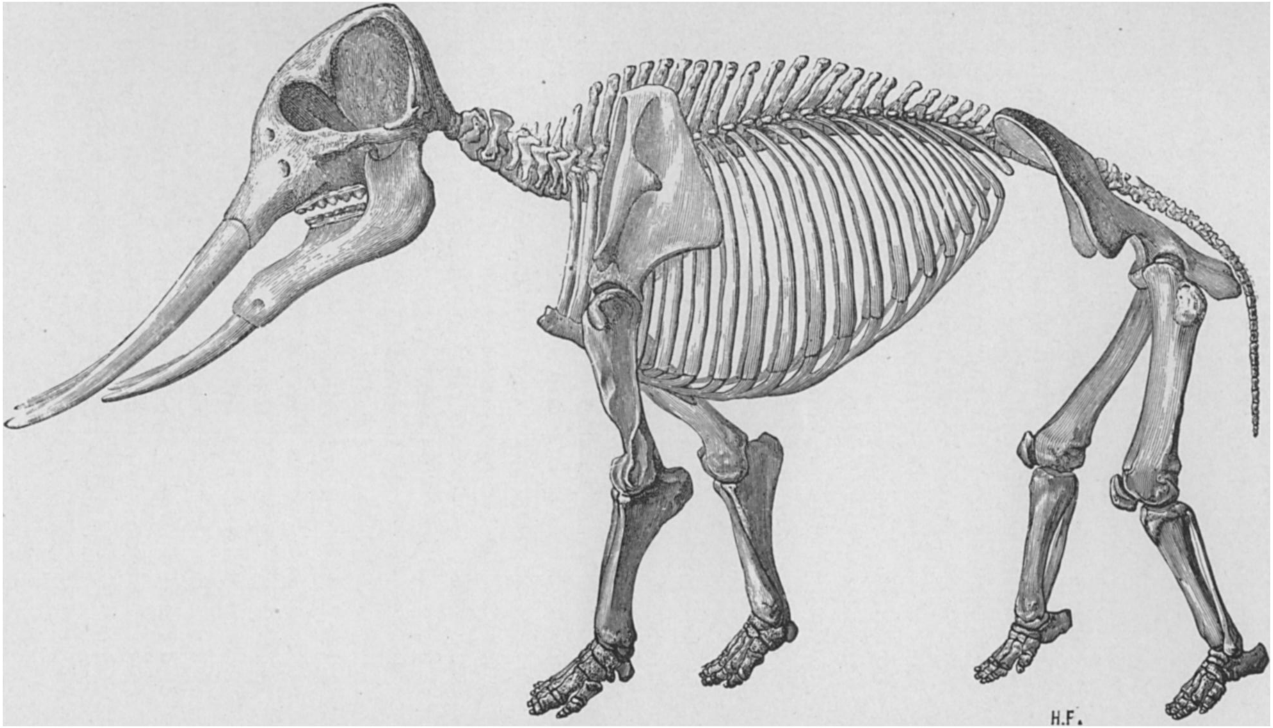
the tuberculated crests of the *T. serridens*, and no important characters appear to separate it from the latter.

The *Mastodon mirificus* Leidy is known from a left ramus of a lower jaw, which supports the last molar. The intermediate molars are probably four-crested (tetralophodont), and the last molar has six crests, and is a large tooth, occupying the entire dentary portion of the lower jaw. In this respect it differs from the *Tetrabelodons campester* and *longirostris*, where the fifth and sixth molars are in simultaneous use. The crests are divided on the middle line, and each half is so expanded as to close the intervening valleys very early in wear. Its symphysis is short and acute. Its nearest ally is the *M. atticus* Wagner, from the Upper Miocene beds of Pentelicus, Greece.

Mastodon americanus Cuv. is the best known and latest in time of the American elephants. It is one of the largest species, and, after *T. brevidens*, possesses the simplest molar dentition. The symphysis of the lower jaw is short and decurved. The skull is wider and less elevated than that of the mammoth, and the tusks are shorter and less recurved. It was very abundant during the Plistocene age throughout North America, from ocean to ocean, and as far south as Mexico; but it has not been found in the latter country. Its remains are usually found in swamps, in company with recent species of Mammalia, and with *Equus fraternus* and *Bos latifrons*. The carbonaceous remains of its vegetable food have been found between its ribs, showing that, like the mammoth, it lived on the twigs and leaves of trees.

It is at first sight curious that this, the simplest of the family of elephants in the characters of its molar teeth, appears latest in time on this continent. But it must be regarded as an immigrant from the Old World, where an appropriate genealogy may be traced. Its nearest ally, *Mastodon borsonii*, existed just anterior to it, during the Middle and Upper Pliocene, and this species was preceded in turn in the Middle and Upper Miocene by the *T. turicensis*, which possesses the same simplicity of the molar teeth. In its mandibular tusks the latter possesses another primitive character, which was nearly lost by its North American descendant.

PLATE XII.



Tetrabelodon augustidens Cuv. From Gaudry.

An ingeniously constructed fraud, consisting of parts of molar teeth of this species fastened together by cement, which was treated with wax, so as to resemble enamel, was described by me as representing a distinct species of this order, under the name of *Cænobasileus tremontigerus.*[1] The specimen was manufactured in southwestern Texas.

Elephas primigenius Blumenbach, the mammoth, was at one time distributed throughout North America, as far south as the valley of Mexico, inclusive. Its remains are found in the Upper Pliocene of Oregon, and in the Pliocene of Mexico, unaccompanied by the *Mastodon americanus*, which had not appeared by that time. In the Eastern States its remains occur with those of the *Mastodon americanus* at the Big Bone Lick, in Kentucky. It was not found in the Port Kennedy, Pennsylvania, Bone-fissure, although the Mastodon was there. This absence may have been accidental. Says Leidy[2] : "The animal (*Elephas primigenius americanus*) was probably of earlier origin, and became earlier extinct than the latter," an opinion which my own observations confirm. Since no earlier species of elephant proper is known from North or South America, we must regard this one as an immigrant from Asia, where, indeed, its remains abound. It remained longer in Siberia than in North America, since whole carcasses have been discovered imprisoned in the ice, near the mouth of the Lena River. These specimens had a covering of long hair, with an under hair of close wool.

Leidy and Falconer have observed that the teeth of the elephants from Eastern North America can be easily distinguished from those of the Mammoth by the greater attenuation of the enamel plates. Leidy also observes that the lower jaw is more acuminate in the former. He proposed, therefore, to distinguish it as a species, using Dekay's name, *E. americanus*. Teeth from Escholtz Bay, Alaska, he regards as belonging to the true *E. primigenius*.

Falconer regarded the true elephant of Texas as a distinct species, which he named *E. columbi.* He distinguished it by the coarse plates of the enamel, and by the wide lower jaw, with curved rami, and short symphysis. So far as the dentition goes, I have specimens of this type from Colorado and from Oregon. The Oregon specimen presents the same type of lower jaw as does one from Texas, in my possession. Specimens from the valley of Mexico are abundant in the museums of the City of Mexico, and their characters do not differ from those from Texas. I have in my museum an entire skull, lacking the lower jaw, (Plate XIV.), from the " orange sand " of the city of Dallas, in Northeastern Texas, which only differs in form from that of the *E. primigenius*, as figured by Blumenbach and Cuvier, in the shorter and wider premaxillary region. This is one-half wider than long (from the molar alveolus)

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[1] "Proceedings American Philos. Society," 1877, p. 584.

[2] "Extinct Mammalia of Dakota and Nebraska," p. 398.

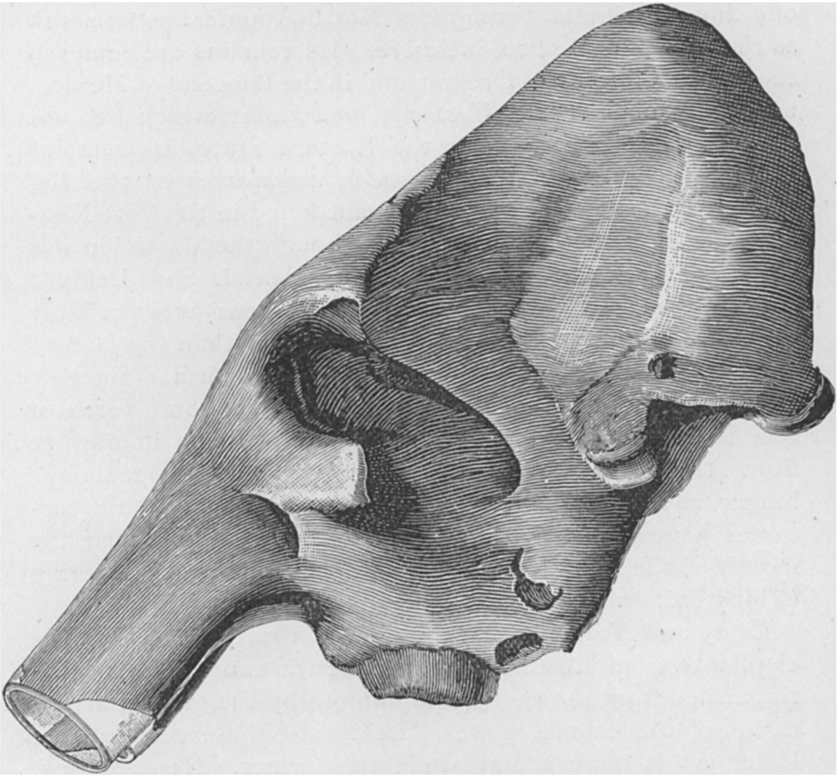

FIG. 9. *Elephas primigenius columbi* Falc., from Texas. Natural size. Original. Profile of skull represented in Plate XIV.

ERRATUM.

Fig. 9, page 208, should read "1/7.7 natural size" in place of "natural size."

while in the Ilford Mammoth in the British Museum, figured by Leith Adams,[1] the length of this region equals the width. The skull agrees with those of the *E. primigenius*, and differs from those of the *E. indicus* in the narrower proportions of the posterior part of the cranium. The teeth are of the coarse-plated *E. columbi* type. The individual is not very large, though old. The diameter of the tusks at the alveolus is 110 mm. In a fragment of a huge specimen from Southwestern Texas, the diameter of the tusk at the base is 210 mm.

As a result, it is not clear that the two American forms can be distinguished as yet from the *Elephas primigenius* or from each other, except as probable subspecies, *E. p. columbi*, and *E. p. americanus*. But more perfect material than we now possess may yet enable us to distinguish one or both of these more satisfactorily. No American species of the family exceeded this one in general dimensions, especially the form *E. p. columbi*.

EXPLANATION OF PLATES.

PLATE IX.

Tetrabelodon campester Cope. Palate with teeth from below, one-fourth natural size; from Loup Fork bed of Kansas. Original.

PLATE X.

Side view of jaws of individual of *Tetrabelodon campester* represented in Plate IX., one-eighth natural size.

PLATE XI.

Tetrabelodon angustidens proavus Cope, mandibular ramus and symphysis from above and in profile, one-sixth natural size. Fig. A, first true inferior molar of a young animal, one-third natural size. Fig. B, last superior premolar of young, perhaps of this species, two-fifths natural size.

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[1] "Memoirs of the the Palæontographical Society," 1879, p. 69. Monograph of the British Fossil Elephants Pl. VI., VII.

PLATE XII.

Tetrabelodon angustidens Cuv. Entire skeleton 1-26 natural size, restored by Gaudry. From the Miocene of France. From Gaudry "Enchainements du Règne Animal."

PLATE XIII.

Tetrabelodon euhypodon Cope, mandibular ramus from above and in profile, one-eighth natural size. From the Loup Fork bed of Kansas. Original.

PLATE XIV.

Elephas primigenius columbi Falc. Cranium. From Plistocene of Texas, 1-7.7 natural size. Original in Mus. E. D. Cope. The white spaces are light-colored bone, except at ends of premaxillaries, which are plaster.

PLATE XV.

Outlines of crania of Proboscidia, much reduced; from Falconer; front views.

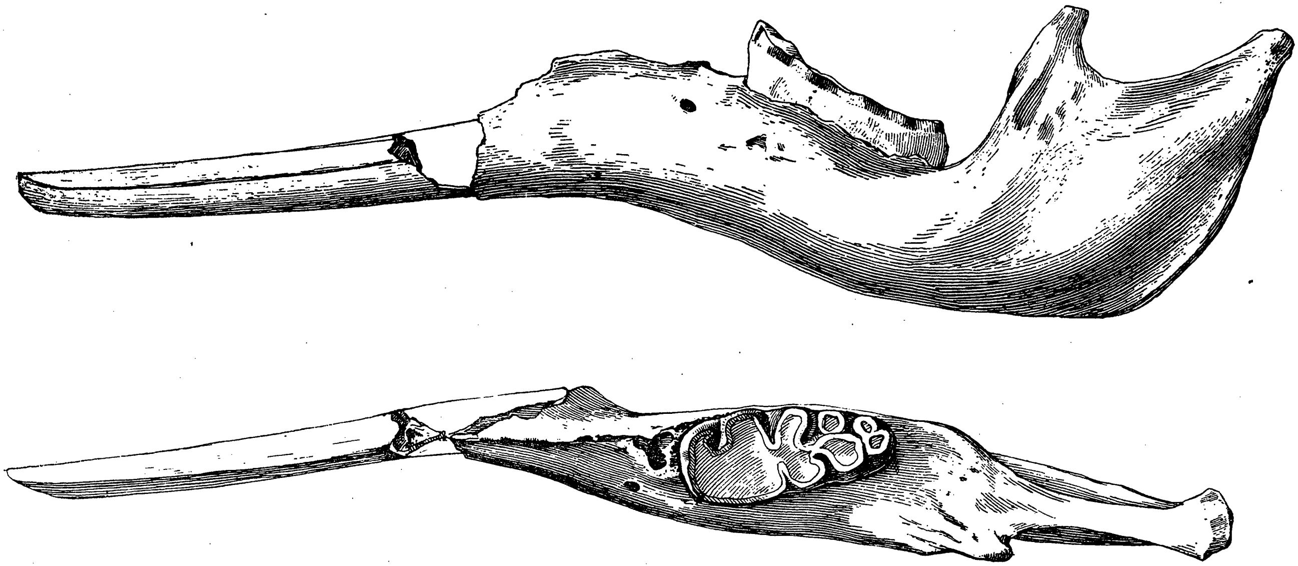
Fig. 1, *Dinotherium giganteum.* Fig. 2, *Mastodon americanus.* Fig. 3, *Dibelodon cordillerarum.* Fig. 4, *Mastodon perimensis.* Fig. 5, *Mastodon sivalensis.* Fig. 6, *Elephas bombifrons.* Fig. 7, *Elephas ganesa.* Fig. 8, *Elephas insignis*, including *a* and *b*, very young. Fig. 9, *Emmenodon planifrons.* Fig. 10, *Elephas africanus.* Fig. 11, *Elephas meridionalis.* Fig. 12, *Elephas hysudricus.* Fig. 13, *Elephas namadicus.* Fig. 14, *Elephas indicus*, including *a*, var. *mukna*, and *b*, young. Fig. 15, *Elephas primigenius*, after Fischer.

PLATE XVI.

Outlines of crania of Proboscidia, much reduced; from Falconer; profiles.

Fig. 1, *Dinotherium giganteum*, from Kaup. Fig. 2, *Mastodon americanus.* Fig. 3, *Tetrabelodon angustidens*, after De Blainville. Fig. 4, *Dibelodon cordillerarum.* Fig. 5, *Mastodon perimensis.* Fig. 6, *Mastodon sivalensis.* Fig. 7, *Mastodon arvernensis*, from Nesti. Fig. 8, *Tetrabelodon longirostris*,

PLATE XIII.



Tetrabelodon euhypodon Cope.

after Kaup. Fig. 9, *Mastodon latidens.* Fig. 10, *Emmenodon elephantoides.* Fig. 11, *Elephas bombifrons.* Fig. 12, *Elephas ganesa.* Fig. 13, *Elephas insignis.* Fig. 14, *Emmenodon planifrons.* Fig. 15, *Elephas africanus.* Fig. 16, *Elephas meridionalis.* Fig. 17, *Elephas hysudricus.* Fig. 18, *Elephas namadicus.* Fig. 19, *Elephas indicus.* Fig. 20, *Elephas primigenius.*

ACROSS THE SANTA BARBARA CHANNEL.

BY J. WALTER FEWKES.

THE island of Santa Cruz, from the Mission Church of Santa Barbara, looks not unlike Capri, from the City of Naples. The same blue sky arches over it, the same Mediterranean haze envelops it, its outlines are softened by its distance, and its cliffs rise equally precipitantly from the sea. In my tarry at Santa Barbara, in the spring of 1887, I had repeatedly turned my eyes seaward, across the channel, longing for the opportunity, which at last came, to cross the intervening waters, and set foot on this island. My trip across the channel was productive of both pleasure and profit, and may not be without interest to my readers.

Although a comparatively narrow channel separates the Santa Barbara islands from the mainland, the means of communication are not always at hand. The enterprising fisherman, Larco, often crosses it in his Italian sailboat, the "Genova," but his accommodations for passengers are more or less limited. The vessel owned by the proprietors of the island was not at my disposal, and the only thing left was to charter a craft for my own use. Fortunately, it was possible to find such a vessel, and I was able to visit the nearest of the Santa Barbara islands, long ago discovered by Cabrillo, upon which, according to some authorities, he was buried.[1]

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[1] Other historians say this intrepid discoverer found his grave at a neighboring island of San Miguel. Certain it is that he was the first European to sail up the Santa Barbara Channel, and that he lost his life on this voyage. His grave, wherever it may be, is not yet marked by monument or commemorative stone.